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BIOSYSTEMATIC STUDY OF CERTAIN SPECIES OF BORAGINACEAE AND SOLANACEAE FAMILY

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ABSTRACT

We have done bio-systemic study of two family namely Boraginaceae and Solanaceae. We considered three plants from each family and observed the parameters such as Stomatal behaviour, Inflorescence, Trichomes, Pollen grains, Stem anatomy, Numerical analysis on each plant. In case of Boraginaceae we found that *Heliotropium indicum* indicated comparability with *Cordia sebestena* in just 12 characters and *Cordia sinensis* in just 11 characters. The *Cordia sebestena* and *Cordia sinensis* demonstrated likenesses in 10 characters. Based on coordinating coefficient it was seen that *Heliotropium indicum* indicated just 48 % likeness with *Cordia sebestena*, and 44% with *Cordia sinensis*. Our discoveries on bio-systemic study of Boraginacea has gained the support from the work Diane et al., 2002 and Altaf et al., 2003. In case of Solanaceae, we discovered that *Datura innoxia* demonstrated similitude with *Lycopersicon esculentum* in just 15 characters and with *Solanum virginianum* in just 12 characters. *L. esculentum* and *S. virginianum* indicated likenesses in 16 characters. Based on coordinating coefficient it was seen that *D. innoxia* demonstrated just 65.21% similarity with *L. esculentum*, and 52.17% with *S. virginianum*. *Lycopersicon esculentum* and *solanum virginianum* indicated 69.56% likenesses. Also, the study helped to distinguish and identify the plant.

INDEX TERMS

Biosystematics, *Heliotropium indicum, Cordia sebestena, Cordia sinensis, Datura innoxia, Lycopersicon esculentum, Solanum virginianum*, Stomatal behaviour, Inflorescence, Trichomes, Pollen grains, Stem anatomy , Numerical analysis.

INTRODUCTION

Biosystematics is an exploratory ordered investigation to a great extent worried about morphological, anatomical, genetical, cytological, substance and palynological perspectives. This part of scientific categorization is the thought of the normal connections among taxa which incorporates the depiction, naming and grouping of plants together with investigations of their development and phylogeny. The utilization of phytomorphological, anatomical, epidermal, palynological, cytological and biochemical investigations in biosystematics can more readily be valued.

FAMILY: BORAGINACEAE

The family Boraginaceae of Dicotyledons incorporates an assortment of bushes, trees, and herbs, totalling around 2000 species in 146 genera discovered around the world, and around 141 species found in India. *Heliotropium indicum* L., *Cordia sebestena* L., *and Cordia sinensis* Lam. are regular Indian species.

Scientific name:- *Heliotropium indicum* L.

Taxonomic description:-

It is a yearly, hirsute plant. It is a typical weed in squander puts and settled zones and is local to Asia. India heliotrope is a yearly, erect, expanded plant that can develop to a tallness of around 15-50 centimeters (5.9-19.7 in.). It has a bristly stem, bearing substituting applaud to oval praise leaves. It has little white, blue or violet blossoms with a green calyx; five stamens borne on a corolla tube; a terminal style; and a four-lobed ovary. It is an upland plant types adjusted to earth bottomland soils and furthermore attack uncovered soil.

Scientific name:- *Cordia sebestena* L.

Taxonomic description:-

It is a little evergreen bush. It is local to the Caribbean area, yet as per Gann et al.(2008) it is local to Florida. It is broadly developed as an elaborate all through the tropics and subtropics region. It is a bush or little tree coming to around 7-8meter tallness (15centimeter breadth). Twigs are bristly. The leaves substitute, enormous, praise, obtuse at pinnacle, unpleasant, much wrinkled or wavy and bushy. Inflorescence is terminal groups. It has huge, red or orange-red blossoms with a green calyx; rounded, at least 4 lobed, ribbed; corolla pipe formed, petals 5-6 and much wrinkled, stamens 5-12. It is develops in poor soils, on coastlines(Petrides 1988) and furthermore beach front embankment, distuebed upland and rockland lounger.

Scientific name:- *Cordia sinensis* Lam.

Taxonomic description:-

It is shows a scope of development structures, from low bush to a multi-stemmed tree up to 12m in stature, local to Egypt, Ethiopia, Kenya and Madagascar it is a tree of bone-dry and semi-dry areas, regularly in riparian zones. It is a little deciduous tree. Leaves are sub-inverse, whole, oblanceolate, peak adjusted and base decreasing into petiole. Inflorescence cymes, blossoms little, white;calyx 4-5 lobed, satiny inside; corolla flaps 4, oval; stamens 4; ovary 4-celled, ovule 1 in every cell, style terminal. It is wet ground and open desert scour.

FAMILY: SOLANACEAE

Solanaceae, the nightshade family of blooming plants with 90 genera and about 2000-3000 species(Heywood-1978) discovered around the world, a significant number of extensive financial significance as nourishment and medication plants. *Datura innoxia* Mill., *Lycopersicon esculentum* Mill., and *Solanum virginianum* L., are regular Indian species.

Scientific name:- *Datura innoxia* Mill.

Taxonomic description:-

It is a lasting pubescent herb, with green or purplish bushy stems. Found along the side of the road and fallows fields to 1500m normal. Tropical and subtropical Asia and Africa, presently generally developed in the hotter areas. Subshrub; branches to some degree crisscross. Leaves whole or calculated with intense projections, applaud, base sideways, zenith intense or taper; petiole long. Blossoms lone in axil, erect; pedicels 1-1.5cm long. Calyx long, cylindrical, 5-lobed, minutely pubescent. Corolla rich white, long, pipe formed; teeth 5, cuspidate. Stamens 5, joined towards the base of corolla tube, included, subequal; fibers bristly at base. Capsule 3cm over, round, secured with short spines, dehiscence unpredictable. Seeds packed, long, smooth, earthy colored.

Scientific name:- *Lycopersicon esculentum* Mill.

Taxonomic description:-

It is little, shaggy herb. It is started in South America however are currently discovered everywhere throughout the world. It is a little, bushy herb, leaves unpredictably pinatisect, denate, furry. Inflorescence is many blossomed cymes, it is yellow in shading; calyx 5-10 lobed, praise lanceolate, tenacious; corolla turn plicate; stamens 5, exserted, elliptical; ovary many-locular; berry globose, red, many seeded natural product.

Scientific name:- *Solanum virginianum* Mill.

Taxonomic description:-

It is a thorny diffuse brilliant green herb. It was debased timberland regions, additionally along side of the road and badlands and fields from the coast to 100m, India, Australia, sandy stream sea shores. It is splendid green herb, prickles yellow, sharp, straight, compacted. Leaves are applaud or elliptic, intense at the peak, shorten at the base, stellately furry on the two sides, thorny along the nerves, sporadically lobed, petiolate, petioles stellately bristly. Inflorescence extra-axillary few-bloomed cyme, peduncles thorny, blossoms pedicellate, pedicels stellately bushy, thorny; calyx campanulate, thickly furry, thorny, flaps praise oval; corolla purple, projections triangular, bristly outside; natural product globose, yellow, seeds subreniform, minutely foveolate.

In the current perception biosystematics of three types of Boraginaceae viz., *Heliotropium indicum, Cordia sebestena* and *Cordia sinensis* and three types of Solanaceae viz., *Datura innoxia, Lycopersicon esculentum* and *Solanum virginianum* was

contemplated. All the six species demonstrated a checked distinction in leaf and inflorescence morphology, stomatal conduct, epidermal trichomes, pollen grain qualities and stem anatomy.

COLLECTION:-

Five plant specimens of each of the three species of Boraginaceae, viz., *Heliotropium indicum, Cordia sebestena, Cordia sinensis* and three species of Solanaceae, viz., *Datura innoxia, Lycopersicon esculentum, Solanum virginianum* were collected from different localities of District Mehsana (Gujarat, India). All the samples are collected and carry on botany lab, M.N.College Visnagar (District Mehsana). The plant specimens were identified by using various available resources such as reference books, web facilities and manuals.

METHOD:-

The epidermis was removed from lower surface of the leaves from each of the sample and was fixed in 20% glycerine. The slides were examined under the light microscope at 10X and 40X. Various anatomical features, such as type of stomata, length and width of stomata, trichomes form, type, length and width were studied. The stomata and hairs size were recorded with the help of a calibrated eyepiece. Pollen grains from fresh plants of each of the six species were collected on a slide and acetolyzed. Acetolyzed pollen grains were subjected to microphotography for study. For anatomical studies stem cross sections of each of the six species were prepared using freshly collected material or material fixed in ethanol with the help of a semi-permanent and permanent slides.

NUMERICAL ANALYSIS:-

All the examined specimens were analyzed by means of Hierarchical Cluster analysis using Euclidean distance measuring similarity and dissimilarity percent (Matching coefficient). The relationships between the three closely related species of Boraginaceae viz., *Heliotropium indicum, Cordia sebestena, Cordia sinensis* and three closely related species of Solanaceae viz., *Datura innoxia, lycopersicon esculentum, Solanum virginianum*.

OBSERVATION

The morphological characters of leaves and inflorescence of the three species of Boraginaceae viz., *Heliotropium indicum, Cordia sebestena* and *Cordia sinensis* have been presented in **Table-1** and **Fig- 1, 2, 3, 4, 5, 6.**

The stomatal behaviour of the three species of Boraginaceae have been presented in **Table-2** and **Fig- 7, 8, 9**.

The trichomes (epidermal hairs) of the three species of Boraginaceae have been depicted in **Table-3** and **Fig- 10, 11, 12**

Pollen grain characteristic for three species of Boraginaceae have been presented in **Table-4** and **Fig-13, 14, 15**

The anatomical features of stem of three species of Boraginaceae showed a typical dicot characters in having conjoint collateral and open vascular bundles in **Table-5** and **Fig- 16, 17, 18**.

The morphological characters of leaves and inflorescence of the three species of Solanaceae viz., *Datura innoxia, Lycopersicon esculentum* and *Solanum virginianum* have been presented in **Table-6** and **Fig- 19, 20, 21, 22, 23, 24**.

The stomatal behaviour of the three species of Solanaceae have been presented in **Table-7** and **Fig- 25, 26, 27.**

The trichomes (epidermal hairs) of the three species of Solanaceae have been depicted in **Table-8** and **Fig- 28, 29, 30,**

Pollen grain characteristic for three species of Solanaceae have been presented in **Table-9** and **Fig- 31, 32, 33**.

The anatomical features of stem of three species of Solanaceae showed a typical dicot characters in having conjoint collateral and open vascular bundles in **Table-10** and **Fig- 34, 35, 36.**

Figure 1*Heliotropium indicum*

Figure 2*Cordia sebestena*

Figure 3*Cordia sinensis*

Plant morphology of three specieses of Boraginaceae

Figure 4 *H. indicum*

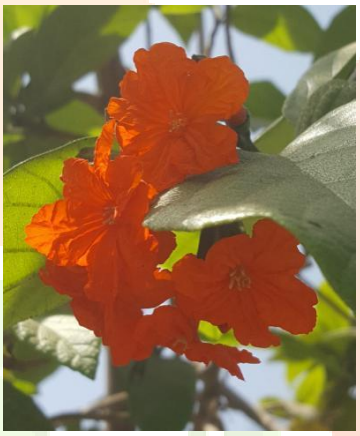

Figure 5 *C. sebestena*

Figure 6 *C. sinensis*

Floral twings of three specieses of Boraginacea

Figure 7 *H. indicum*

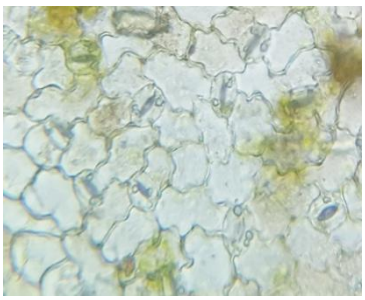

Figure 8 *C. sebestena*

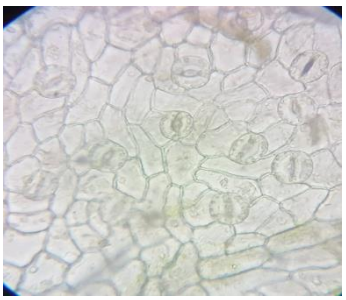

Figure 9 *C. sinensis*

Stomata and subsidiary cells of three specieas of Boraginaceaae

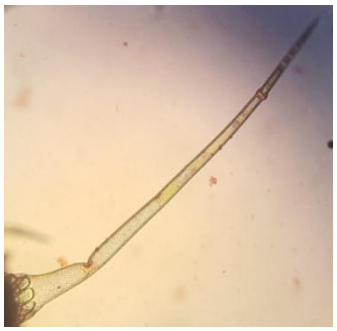

Figure 10 *H. indicum*

Figure 11 *C. sebestena*

Figure 12 *C. sinensis*

Trichomes of three species of Boraginaceae

Figure 13 *H.indicum*

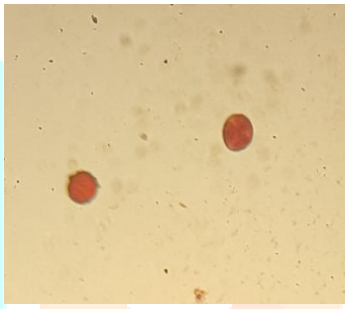

Figure 14 *C. sebestena*

Figure 15 *C.sinensis*

Pollen grains of three species of Boraginaceae

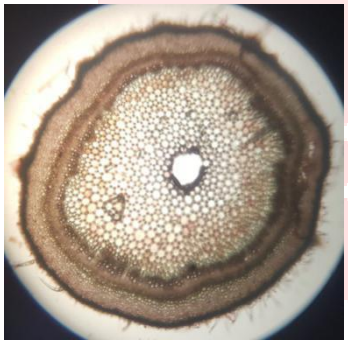

Figure 16 *H.indicum*

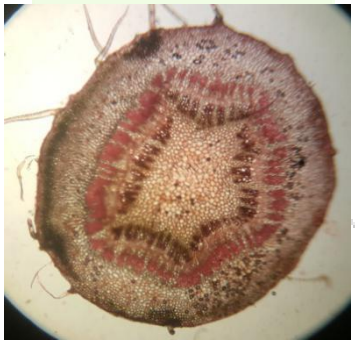

Figure 17 *C. sebestena*

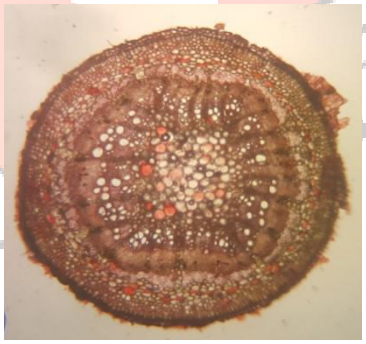

Figure 18 *C.sinensis*

Stem anatomy of three species of Boraginaceae

Figure 19 *Datura innoxia*

Figure *20Lycopersicon esculentum*

Figure 21 *Solanum virginianum*

Plant morphology of three speciese of Solanaceae

Figure 22 *D. innoxia*

Figure 23 *L. esculentum*

Figure 24 *S. virginianum*

Floral twings of three species of Solanaceae

Figure 25 *D. innoxia*

Figure 26 *L. esculentum*

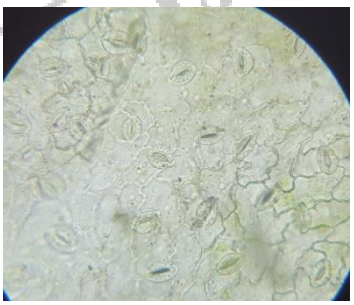

Figure 27 *S. virginianum*

Stomata and subsidiary cells of three species of Solanaceae

Figure 28 *D. innoxia*

Figure 29 *L. esculentum*

Figure 30 *S. virginianum*

Trichomes of three species of Solanaceae

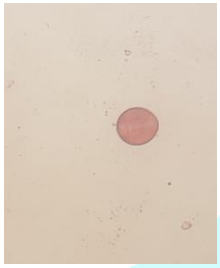

Figure 31 *D. innoxia*

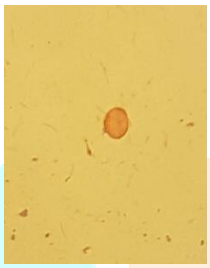

Figure 31 *L. esculentum*

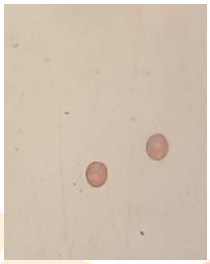

Figure 33 *S. virginianum*

Pollen grains of three species of Solanaceae

Figure 34 *D.innoxia*

Figure 35 *L.esculentum*

Figure 26 *S. virginianum*

Stem anatomy of three species of Solanaceae

Table.1: Leaf and Inflorescence Characters of Three Species of Boraginaceae

Characters analysed	Species of Boraginaceae		
	Heliotropium indicum	*Cordia sebestena*	*Cordia sinensis*
Leaf shape	Ovate	Ovate	Oblanceolate
Venation in Leaves	Hypodromous	Brachidodrome	Brachidodrome
Length of leaves in cm	1.3 to 6.2	4.3 to 16	2.4 to 9.3
Width of leaves in cm	0.9 to 3.7	2.5 to 9.3	1.1 to 3
Inflorescence type	Scorpioid cyme	Terminal cyme	Terminal cyme
Inflorescence colour	White to pale blue	Orange-red	White
Inflorescence length in cm	5 to 16.7	6.5 to 10	4 to 5.3

Table.2: Stomatal Behavior of Three Species of Boraginaceae

Characters analysed	Species of Boraginaceae		
	Heliotropium indicum	*Cordia sebestena*	*Cordia sinensis*
Stomatal type	Anisocytic	Anomocytic	Anomocytic
Length of stomata in mm	2	2	2.8
Width of stomata in mm	1.4	1.4	2.4

Table.3: Trichome Characters of Three Species of Boraginaceae

Characters analysed	Species of Boraginaceae		
	Heliotropium indicum	*Cordia sebestena*	*Cordia sinensis*
Glandular hair	Present	Present	Present
Unicellular hair	Present	Present	Present
Hair density	Dense	Dense	Less dense
Hair wall	Smooth	Rough	Smooth
Hair vestibule	Hollow	Filled	Hollow
Hair base	Oval	Pluricellular	Pluricellular
Length of hair in mm	6.44 ± 154.5	34.0 ± 44.16	3.68 ± 13.8
Width of hair in mm	0.92 ± 15.64	0.92 ± 4.6	1.84 ± 3.0

Table.4: Pollen Grain Characters of Three Species of Boraginaceae

Characters analysed	Species of Boraginaceae		
	Heliotropium indicum	*Cordia sebestena*	*Cordia sinensis*
Length of Pollen in µm	36.8	27.6	36.8
Width of Pollen in µm	27.6	36.8	46
Shape of Pollen	Elliptical	Globular	Globular
Pollen types	Tricolpate	Tricolpate	Tricolpate

Table.5: Stem Anatomical Characters of Three Species of Boraginaceae

Characters analysed	Species of Boraginaceae		
	Heliotropium indicum	*Cordia sebestena*	*Cordia sinensis*
Epidermis	One layered	One layered	Two layered
Hypodermis	Two layered	One layered	Two layered

Fascicular and Interfascicular cambium	Present	Present	Present
Cortex	Oval	Oval	Round
Pith cells	Round	Round	Round

Table.6: Leaf and Inflorescence Characters of Three Species of Solanaceae

Characters analysed	Species of Solanaceae		
	Datura innoxia	*Lycopersicon esculentum*	*Solanum virginianum*
Leaf shape	Ovate	Ovate	Elliptic
Venation in Leaves	Compotodromous	Compotodromous	Compotodromous
Length of leaves in cm	4.3 to 15.5	1.3 to 6.3	3.5 to 7
Width of leaves in cm	2 to 8.8	0.9 to 3.5	2.5 to 4.5
Inflorescence type	Solitary cyme	Solitary cyme	Cyme
Inflorescence colour	White	Yellow	Purple
Inflorescence length in cm	16 to 17	2.5 to 3	2 to 3.3

Table.7: Stomatal Behavior of Three Species of Solanaceae

Characters analysed	Species of Solanaceae		
	Datura innoxia	*Lycopersicon esculentum*	*Solanum virginianum*
Stomatal type	Anisocytic	Anomocytic	Anisocytic
Length of stomata in mm	3	2.2	2.8
Width of stomata in mm	2.4	1.8	2

Table.8: Trichome Characters of Three Species of Solanaceae

Characters analysed	Species of Solanaceae		
	Datura innoxia	*Lycopersicon esculentum*	*Solanum virginianum*
Glandular hair	Present	Present	Present
Multicellular hair	Present	Present	Present
Hair density	Dense	Dense	Less dense
Hair wall	Smooth	Smooth	Smooth
Hair vestibule	Filled	Filled	Filled
Hair base	Oval	Oval	Oval
Length of hair in mm	11.04 ± 34.04	18.9 ± 34.96	5.52 ± 9.2
Width of hair in mm	1.84 ± 2.2	1.46 ± 2.6	1.84 ± 3.68

Table.9: Pollen Grain Characters of Three Species of Solanaceae

Characters analysed	Species of Solanaceae		
	Datura innoxia	*Lycopersicon esculentum*	*Solanum virginianum*
Length of Pollen in µm	82.8	32.2	23.6
Width of Pollen in µm	73.6	32.2	23.6
Shape of Pollen	Globular	Spheroidal	Globular
Pollen types	Colporate	Colporate	trizonocolporate

Table.10: Stem Anatomical Characters of Three Species of Solanaceae

Characters analysed	Species of Solanaceae		
	Datura innoxia	*Lycopersicon esculentum*	*Solanum virginianum*
Epidermis	One layered	One layered	One layered
Hypodermis	Three layered	Two layered	Two layered
Fascicular and Interfascicular cambium	Present	Present	Present
Cortex	Round	Oval	Oval
Pith cells	Round	Round	Round

CONCLUSION

Table.11 : Numerical Analysis With Reference to Morphological, Anatomical and Palynological Features of Boraginaceae Species

Character analysed	Species of Boraginaceae		
	Heliotropium indicum	*Cordia sebestena*	*Cordia Sinensis*
Ovate leaf-1; Oblancelate-2	1	1	2
Venation, Hyphodromous-1; Brachidodrome-2	1	2	2
Scorpioid cyme-1; terminal cyme-2	1	2	2
Length of inflorescence, $< 6.0\ cm - 1; > \mathbf{6.0\ cm - 2}$	2	2	1
Flower colour, white-1; orange-red-2	1	2	1
Anisocytic stomata-1; anomocytic stomata-2	1	2	2
Stomatal density, dense-1; less dense-2	1	1	2
Stomatal length, $< 2mm - 1; > \mathbf{2mm - 2}$	1	1	2
Epidermal cells, wavy-1; Straight-2	2	1	2
Glandular hairs, present-1; absent-2	1	1	1
Unicellular hairs-1; Multicellular hairs-2	1	2	1
Hair density,dense-1; Less dense-2	1	1	2
Hair wall,smooth-1; Rough-2	1	2	1
Hair vestibule,hollow-1; Filled-2	1	2	1
Hair base,oval-1; pluricellular-2	1	2	2
Colpate pollen-1; Non-colpate pollen-2	1	1	1
Shape of pollen,elliptical-1; globular-2	1	2	2
Stem epidermis,one layered-1; Two layered-2	1	1	2
Hypodermis,one layered-1; Two layered-2	2	1	2
Fascicular cambium,present-1; absent-2	1	1	1
Interfascicular cambium, present-1;absent-2	1	1	1
Cortical cells, oval-1; Round-2	1	1	2
Pith cells, rounded-1; Oval-2	1	1	1

Numerical examination regarding morphological, stomatal, pollen grains, trichomes and stem anatomy was completed for 23 characters and has been introduced in Table-11. It was discovered that *Heliotropium indicum* indicated comparability with *Cordia sebestena* in just 12 characters and *Cordia sinensis* in just 11 characters. *Cordia sebestena* and *Cordia sinensis* demonstrated likenesses in 10 characters. Based on coordinating coefficient it was seen that *Heliotropium indicum* indicated just 48 % likeness with *Cordia sebestena*, and 44% with *Cordia sinensis*. Furthermore, this strategy is helpful for the recognize the plants as well. The current discoveries gain support from the work Diane et al., 2002, Altaf et al., 2003, Qureshi, 1985, Wael taha and Kasem, 2015. Wael Taha and Kasem (2015) have contemplated the anatomical and morphological characters of seven types of Heliotropium and discovered pretty much comparable outcomes.

Table.12 : Numerical Analysis With Reference to Morphological, Anatomical and Palynological Features of SolanaceaeSpecies

Character analysed	Species of Solanaceae		
	Datura innoxia	*Lycopersicon esculentum*	*Solanum virginianum*
Ovate leaf-1; elliptic-2	1	1	2
Venation, campotodromous-1; Brachidodrome-2	1	1	1
Scorpioid cyme-1; cyme-2	1	1	2
Length of inflorescence $< 4.0cm - 1; > \mathbf{4.0cm - 2}$	2	1	1
Flower colour, white-1; yellow-2; purple-3	1	2	3
Anisocytic stomata-1; anomocytic stomata-2	1	2	1
Stomatal density, dense-1; less dense-2	1	1	2
Stomatal length ,$< 2.8mm - 1$;$> \mathbf{2.8mm - 2}$	2	1	1
Epidermal cells, wavy-1; Straight-2	2	1	1
Glandular hairs, present-1; absent-2	1	1	1
Unicellular hairs-1; Multicellular hairs-2	2	2	2
Hair density,dense-1; Less dense-2	1	1	2
Hair wall,smooth-1; Rough-2	1	1	1
Hair vestibule,hollow-1; Filled-2	2	2	2
Hair base,oval-1; Globular-2	1	1	1
Colpate pollen-1; Non-colpate pollen-2	1	1	1
Shape of pollen, globular-1; Spheroidal-2	1	2	1
Stem epidermis,one layered-1; Two layered-2	1	1	1
Hypodermis,two layered-1; Three layered-2	2	1	1
Fascicular cambium,present-1; absent-2	1	1	1
Interfascicular cambium, present-1;absent-2	1	1	1
Cortical cells,oval-1; Round-2	2	1	1
Pith cells, round-1; Oval-2	1	1	1

Numerical examination regarding morphological, stomatal, pollen grains, trichomes and stem anatomy was done for 23 characters and has been introduced in Table-12. It was discovered that *Datura innoxia* demonstrated similitude with *Lycopersicon esculentum* in just 15 characters and with *Solanum virginianum* in just 12 characters. *L. esculentum* and *S. virginianum* indicated likenesses in 16 characters. Based on coordinating coefficient it was seen that *D. innoxia* demonstrated just 65.21% similarity with *L.*

esculentum, and 52.17% with *S. virginianum. Lycopersicon esculentum* and *solanum virginianum* indicated 69.56% likenesses. Also, this strategy is valuable for the distinguish the plant.

REFERENCE

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